



Development, Demonstration, and Field Testing of Enterprise-Wide Distributed Generation Energy Management System

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Agenda

- **Overview**
- **DER Network Primary Responsibilities**
- **DER Network Design**
- **DER Network Responsibilities**
- **RealEnergy Impact**
- **RealEnergy NREL Information Site – Website Design**
- **Physical Device Selection**
- **Interconnection**
- **Conclusion**



Overview – The Mission

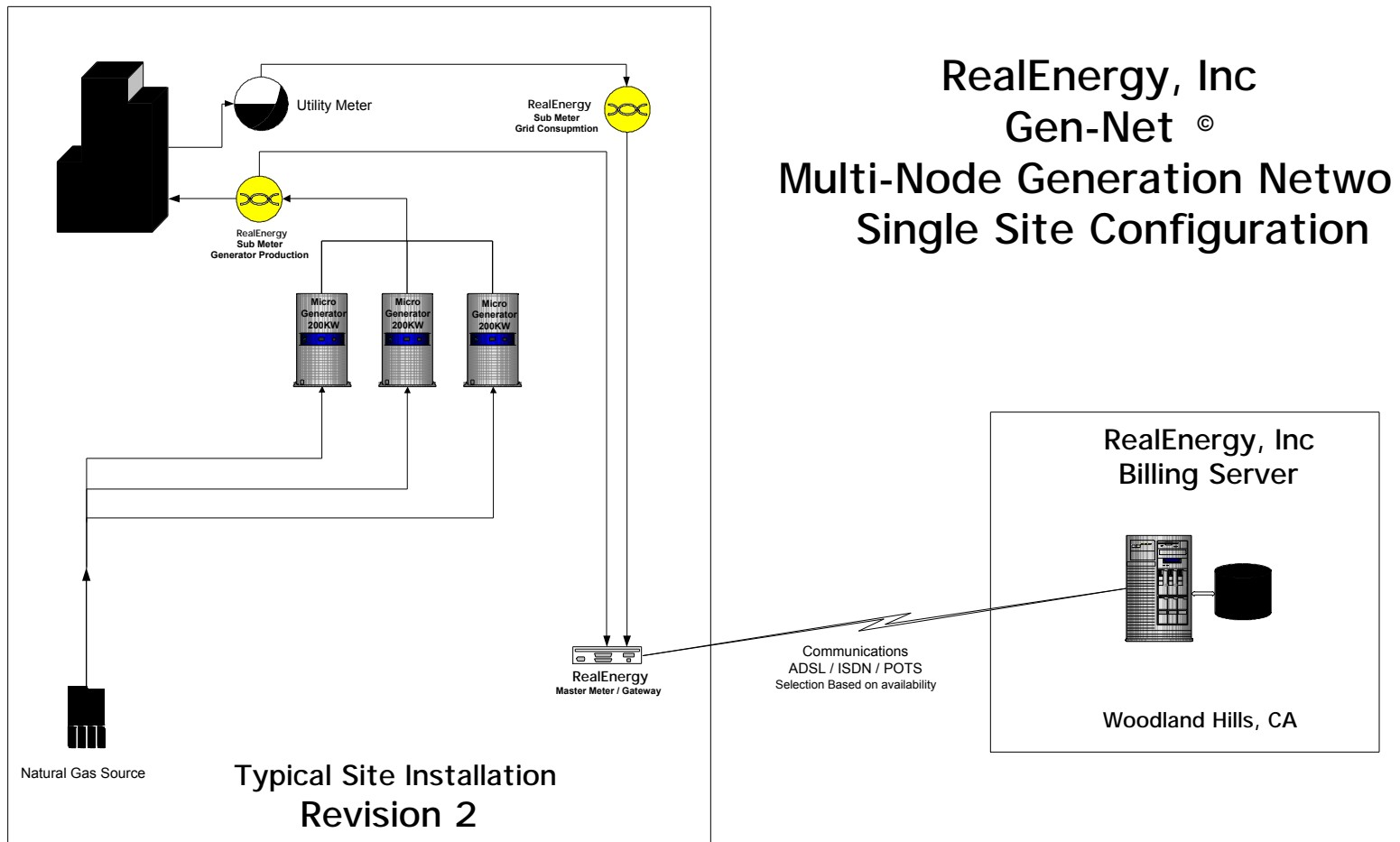
- The concept was simple, find better ways to power the cities of tomorrow using clean, efficient and renewable DER. To integrate the most technologically advanced devices and software and improve the way we distribute and use our Planet's resources.
- The challenge was how to manage and control resources spread over a wide and diverse area. While advice was freely available without solicitation, no entity had an integrates solution available:
an **Enterprise-Wide Distributed Generation Energy Management System**
- Many packaged “solutions” were evaluated, but none were quite right. However, the one thing that kept coming perfectly clear is that a simple and open architecture was the solution that would ultimately lead to success.
- RealEnergy Engineers and Staff made the decision to write the specification in house and then use its own staff and selected vendors to develop a solution that we knew would work. Our Real World Experience is now becoming one of this industry's greatest assets.

DER Network Primary Responsibilities

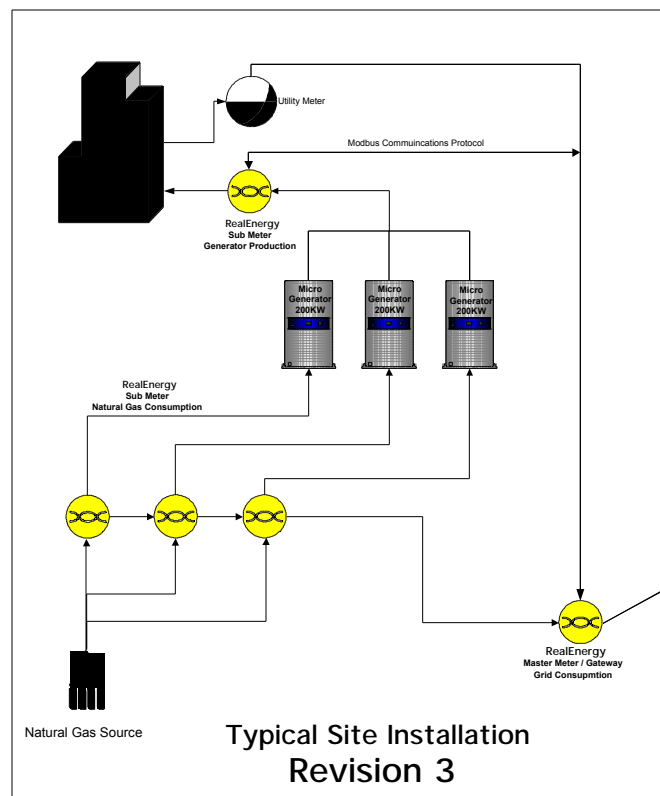
- Generation Network (**Gen-Net**)
 - Primary Responsibilities
 - Integration
 - **C**ommunications
 - **M**etering
 - **B**illing
 - **M**onitoring
 - **A**larming
 - **C**ontrol
 - Secondary Responsibilities
 - Analysis
 - Information Sharing (Clients, Utilities, NREL)
 - New Product Evaluation
 - Cost analysis
 - Feasibility
 - Risk / Reward study

ICMBMAC

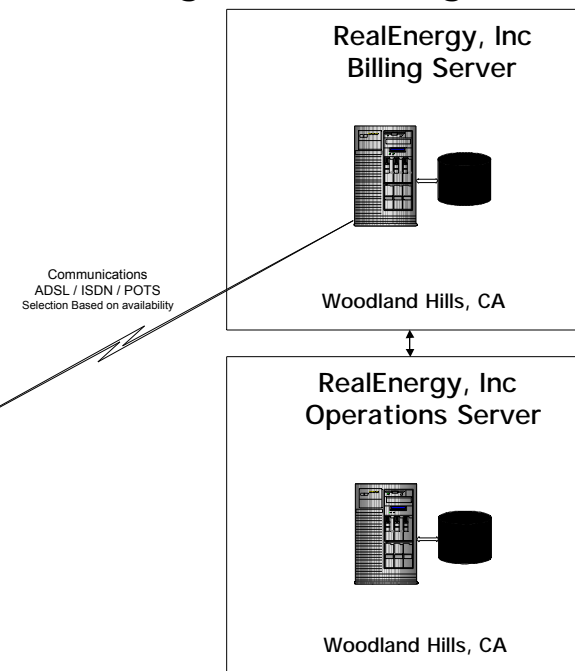
Generator Network Design – Phase 1 (Billing Cash Register)



Generator Network Design – Phase 2 (Billing/Monitoring)



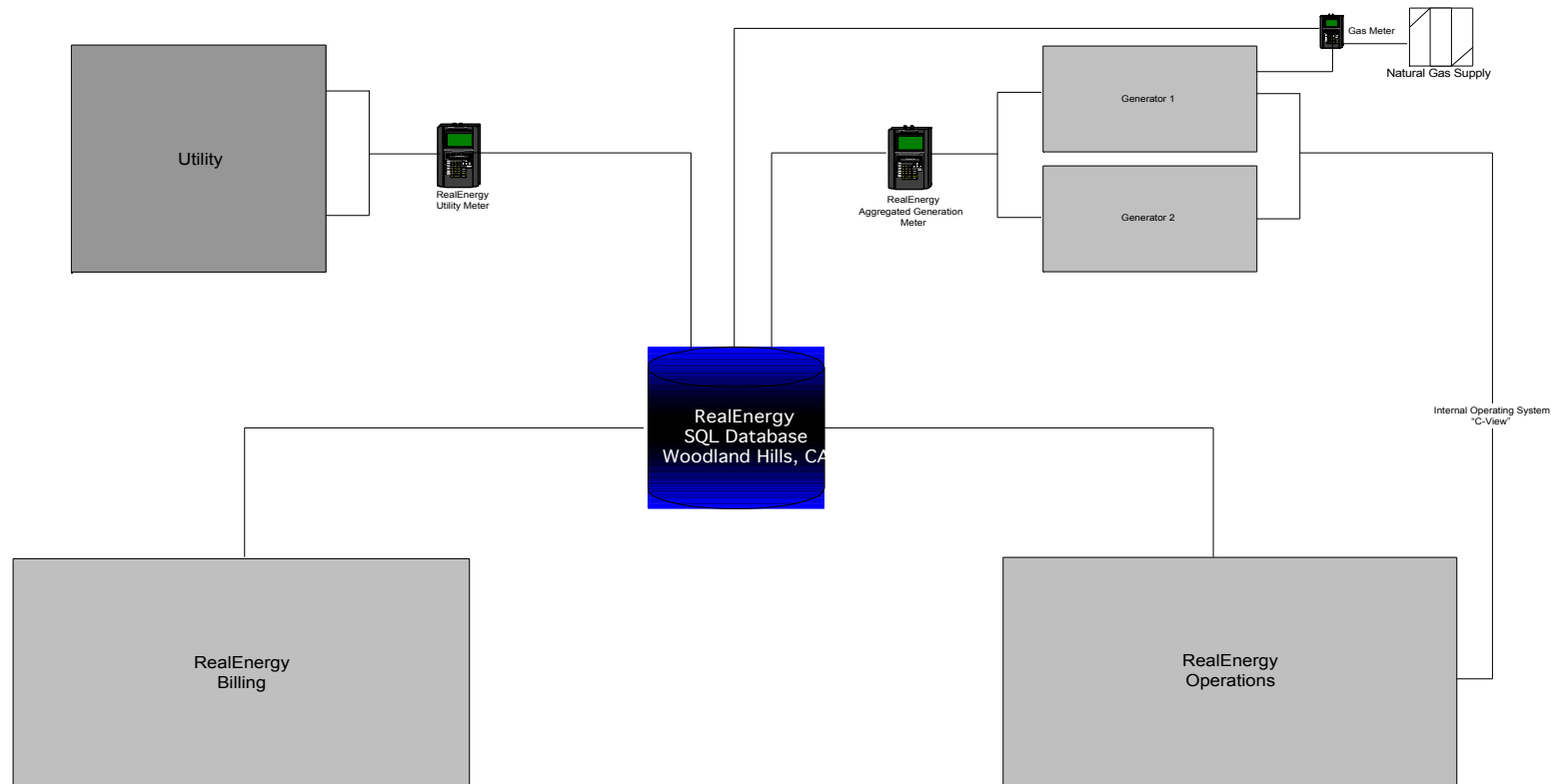
RealEnergy, Inc Gen-Net[®] Multi-Node Generation Netwo Single Site Configuration



Generator Network Design – Phase 2

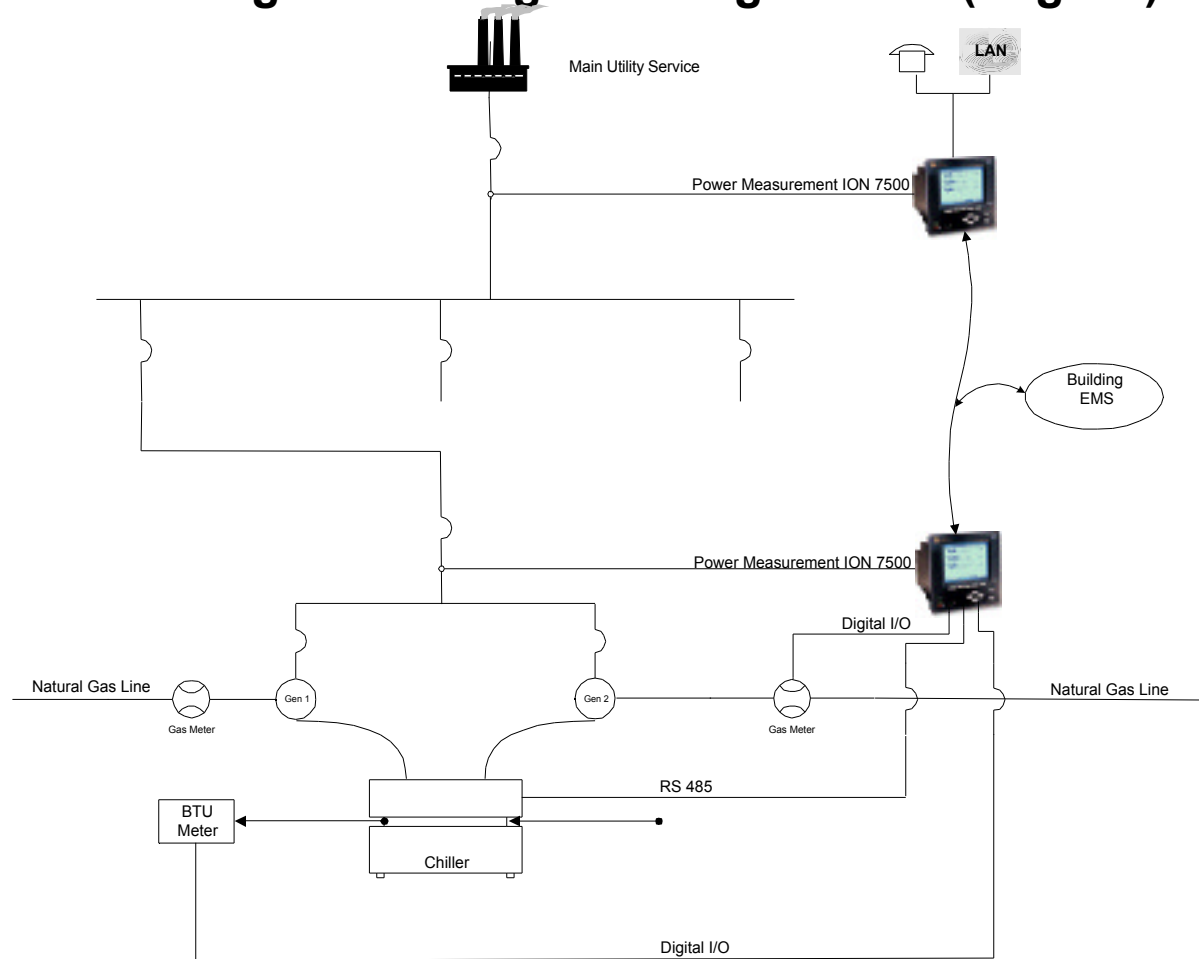
Billing/Monitoring/Alarming (Logical)

Typical 2 Generator Installation
(No Chiller)

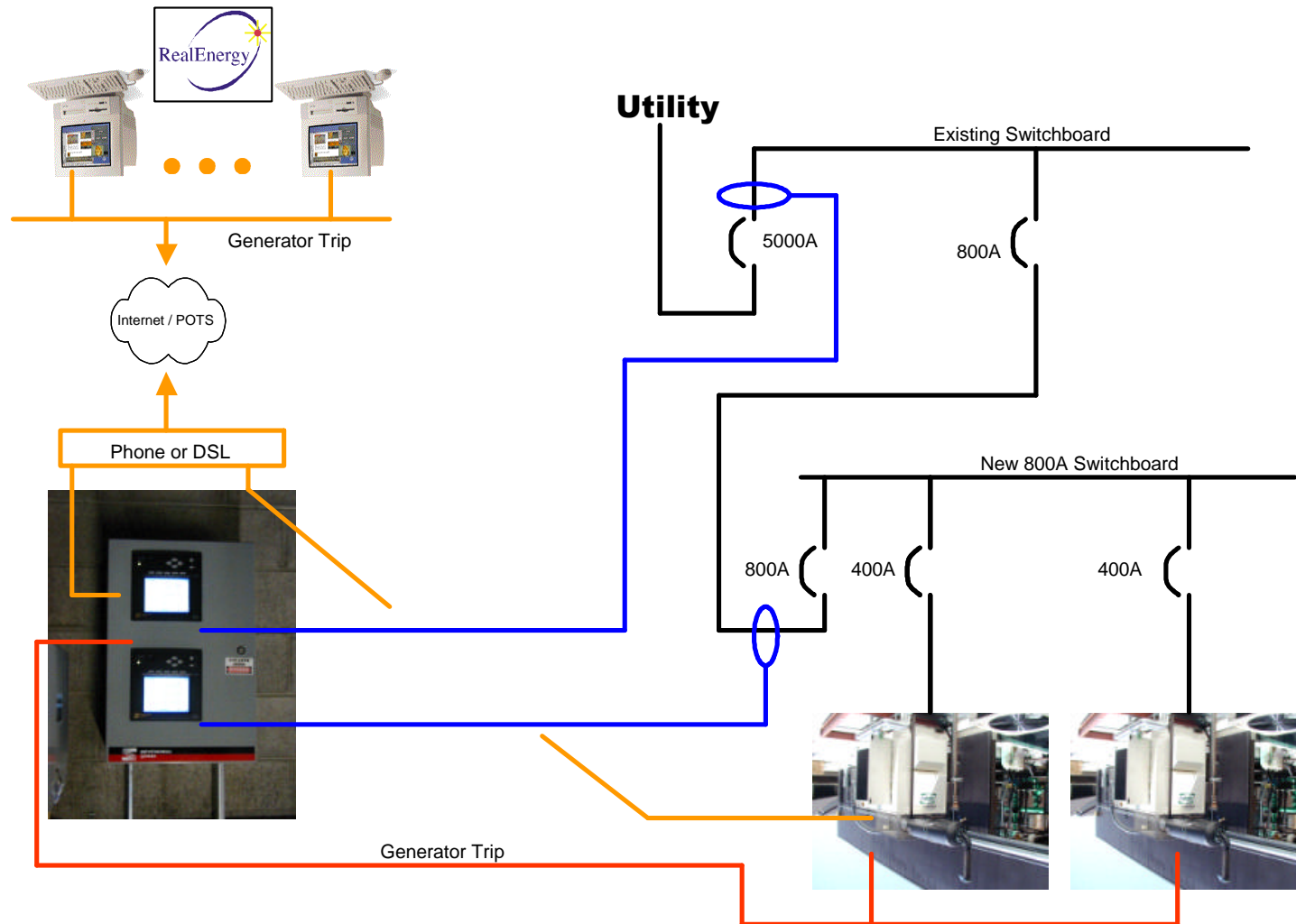


DER Network Design – Phase 3

Billing/Monitoring/Alarming/Control (Logical)



DER Network Protection Design– Phase 3 (Physical)





DER Network Responsibilities (Specific)

- Generation Network (**Gen-Net**)
 - Primary Responsibilities
 - **Integration**
 - System Design
 - Contractor Selection
 - Design Review
 - Work Authorization
 - Communications Planning
 - Communications Integration
 - Management of contractors and scheduling
 - Validation
 - **Communication**
 - POTS
 - Broadband (ADSL/ISDN)



DER Network Responsibilities (Specific)

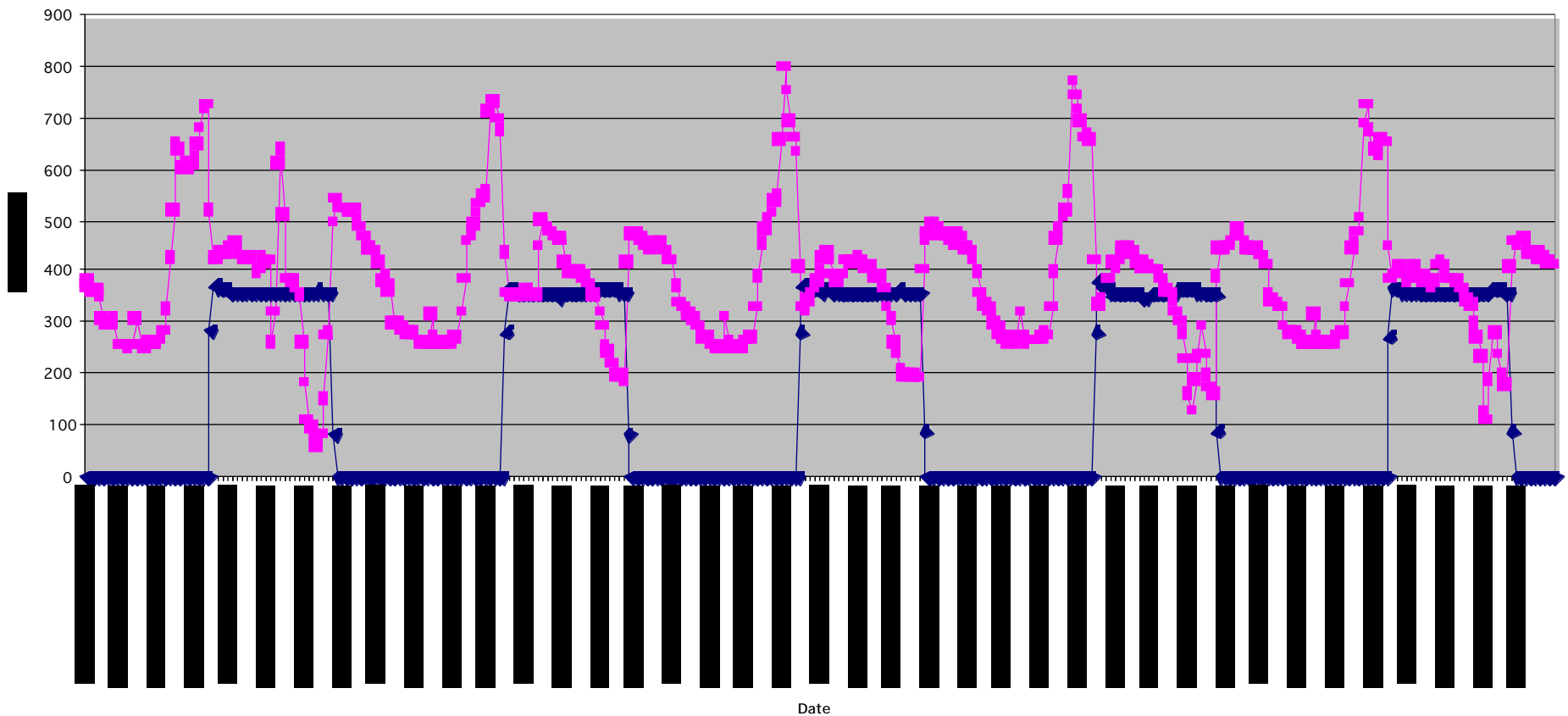
- Generation Network (**Gen-Net**)
 - Primary Responsibilities
 - **Metering**
 - Device Selection
 - Device Configuration (Options)
 - Ethernet Card
 - Modem
 - Internal Storage Capacity
 - Communication Protocol (Modbus)
 - Output Information Selection
 - Points List
 - Output Calibration and Validation
 - **Billing**
 - Database Design
 - MS SQL
 - Database Creation
 - Database Management
 - Database Backup
 - Database Validation
 - Report Design Review
 - Discrepancy Resolution
 - Two Click Bill Creation



DER Network Responsibilities (Specific)

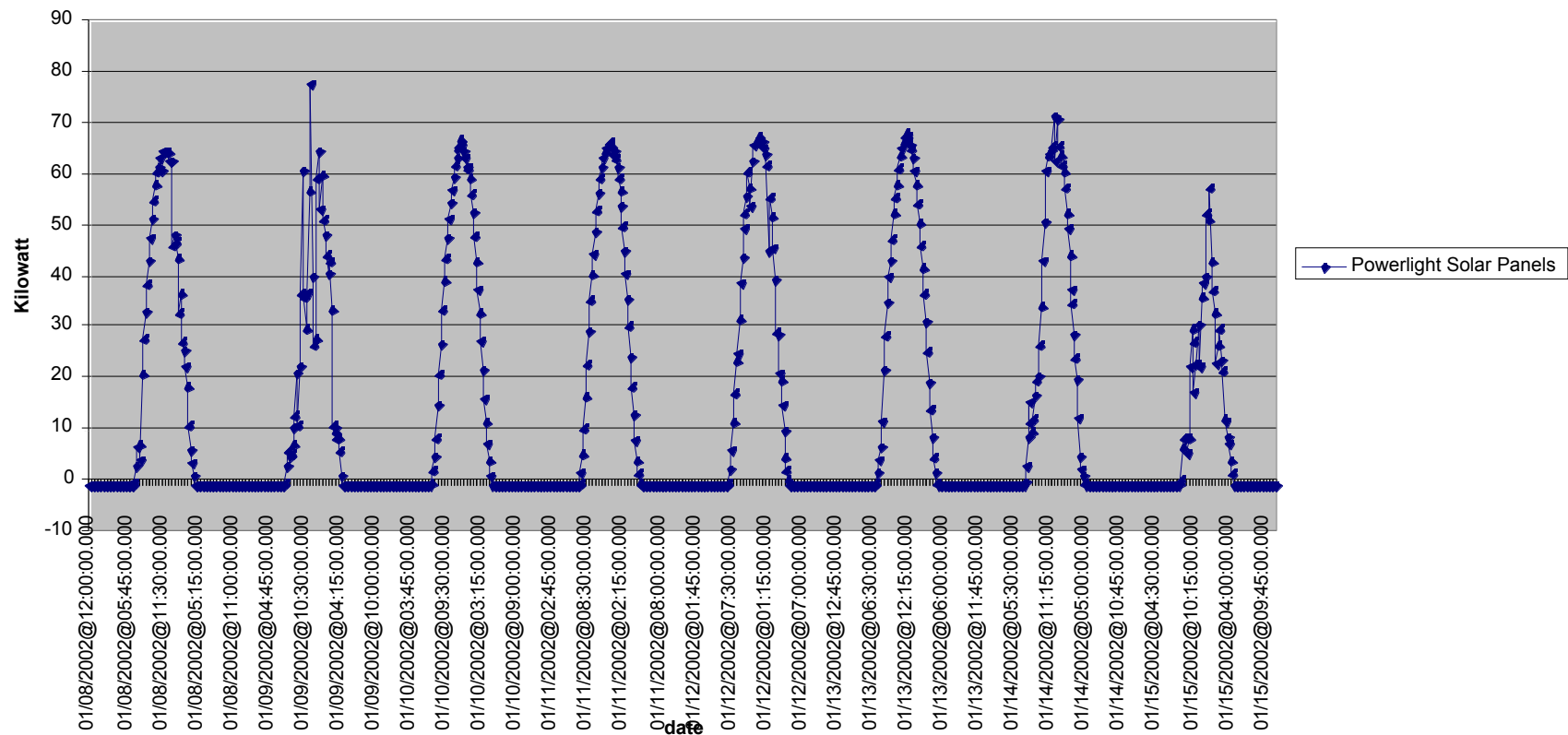
- Generation Network (**Gen-Net**)
 - Primary Responsibilities
 - **Monitoring (Reactive)**
 - Daily
 - All Sites Polled 15 minutes prior to start up to verify communications
 - All Sites Polled 15 minutes after startup to verify normal Operations
 - All Sites Polled mid-day querying for abnormalities
 - All Sites Polled at 12:00am for daily production
 - **Alarming**
 - Polling
 - » Site
 - » Portfolio
 - Active Notification (including production value, Run, Start, and Stop)
 - **Control**
 - Start
 - Stop
 - Schedule
 - Economic Dispatch

RealEnergy Impact – Los Angeles, CA – 400KW Generation Site



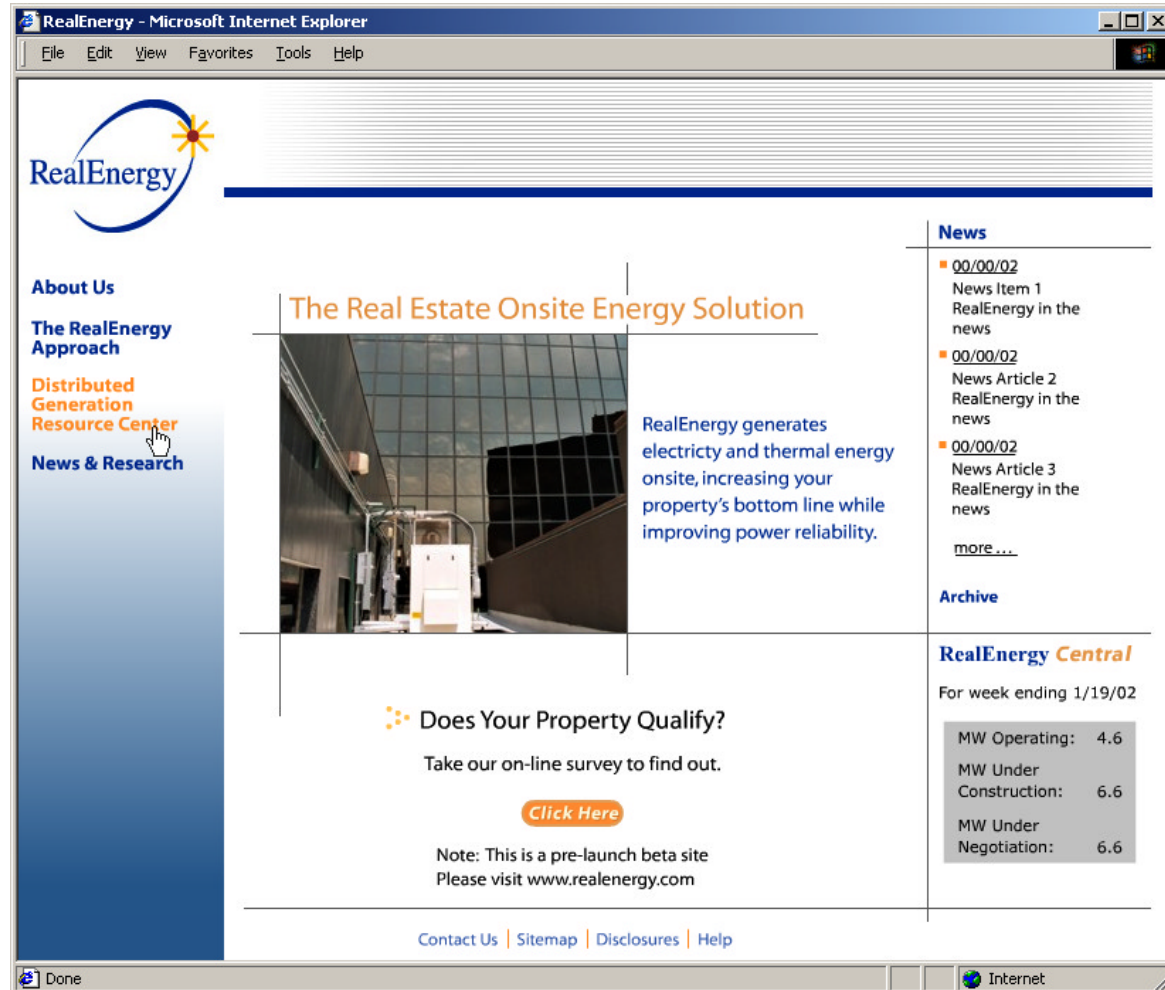


RealEnergy Impact – Fountain Valley, CA – 110 kW Solar Site





RealEnergy NREL Information Site – Website Design





RealEnergy NREL Information Site – Website Design





RealEnergy NREL Information Site – Website Design



RealEnergy NREL Information Site – Website Design





Physical Device Selection – RealEnergy's Current Communications

- **Power Measurement ION 7500**
 - Internal Ethernet and Modem
 - MODBus internal Communications Protocol
 - Digital & Analog I/O Points to support other equipment on site
 - Active notification from devices
 - Wave Form Capture for Analysis
 - Sag / Swell Statistics including time of event, duration and cause
 - Huge 4^{1/2} Display offers full Disclosure to interested parties
- **Communications from Generation Site to Operation Center**
 - ADSL
 - ISDN
 - POTS
- **Energy Information System (EIS)**
 - Final vendor selected – Power Measurement LTD
 - All current and future controls can be integrated into this device
 - Device also performs Beckwith Relay Protection Test Approval
 - Integration of meter into Generator Control System in Progress
 - Integration of meter into BCS in Progress





Overview – Interconnection Problems

- Rule 21 (California) Started w/ good intentions and much inertia
- Initial utility lack of support for DG projects
- Inconsistency and among utilities as to interpretation and application of Rule 21
- Utility vagueness as to requirements
- Turn around for applications as per Rule 21
 - Initial Review: 10 days; Supplemental Review: 20 days
- No formal notification as to when “clock starts” or confirmation of receipt
 - Onus is placed on RE to follow up; Utility does not take responsibility
- No standard IC application (has been rectified)
- Utility unwillingness to provide a sample drawing package per requirements
- High learning curve for Utilities to understand DG projects
 - Utilities try to place at the expense of RE
- Lack of knowledge of their own distribution and protection systems
- Difficult to get final authorization - utilities come up with what appears to be unending requirements/requests (as if testing RE)



Overview – Interconnection Good News

- After working with the California Utilities, they have all shown a remarkable degree of cooperation and willingness to work together to resolve problems and make the process better.
- CEC/CPUC continue to conduct monthly workshops with all interested parties to resolve issues on a statewide basis



Conclusion

- The challenges have been monumental, but the progress has been very encouraging. RealEnergy has identified, addressed and documented the practical application of implementing Enterprise Wide Distributed Energy Resources.
 - Defined Communications Requirements
 - Developed Billing, Monitoring, Alarm and Control Requirements
 - Tested in the field Billing, Monitoring, Alarming and Basic Control
 - Determined Interconnection Requirements
 - Collecting a history of building and DER performance data
 - Developed a website to share real DER performance information
- RealEnergy has now successfully integrated into every Major utility district in California except SMUD.
- Next Steps:
 - Integrate advanced control w/ economic dispatch
 - Standardize hardware & software specifications
 - Optimize and improve systems based on initial test applications
 - Move to next phase of web development
 - Finish reporting of project
- This has by no means been easy, but the solution (for RealEnergy, the Industry, and the Environment) is worth the fight.